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JARI J. MARJANEN

ENVIRONMENTAL EMISSION DATA – INTERNATIONAL COMPARABILITY

STUDY UPON THE NEED FOR INTERNATIONAL HARMONIZATION OF THE RELEVANT DETERMINATION PROCEDURES

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Abstract

Results from emission measurements are used in many ways in international and national connections. One can mention international conventions, environmental statistics, and different economic instruments, like ecolabels and EMAS.

This publication partially continues the previous report published in No 581 of the Mimeograph Series of the National Board of Waters (Survey of Methods for Measuring Discharges in Some Countries).

This report gives a short illustration about the importance and need for harmonization of pollution emission and discharge measurements.

As a conclusion, the report stresses the importance and need for actions to be taken in the field and lists, as examples, bodies which may be responsible for taking active role or step forward in the matter.

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Environmental protection, emissions, emission measurements, harmonization of emission measurements, measurement standards, air pollution control, marine pollution control, international environmental law, economic instruments, international conventions, ecolabels

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Tiivistelmä

Päästömittausten tuloksia käytetään monin tavoin kansainvälisissä ja kansallisissa yhteyksissä. Käyttökohteista voidaan mainita kansainvälisten ympäristönsuojelusopimusten asettamien velvoitteitten täyttämisen seuranta, ympäristötilastot sekä erilaiset taloudelliset ohjauskeinot, kuten ympäristömerkinnät ja EMAS.

Tämä julkaisu on osittain jatkoa vesi- ja ympäristöhallituksen monistesarjan numerossa 581 julkaistulle aiemmalle selvitykselle (Päästöjen mittausmenetelmien kartoitus).

Tämä raportti perustelee lyhyesti päästömittausten harmonisoinnin tarvetta ja tärkeyttä.

Lopuksi raportti kuvailee asiassa tarvittavien toimenpiteitten tärkeyttä ja merkitystä sekä luettelee esimerkinomaisesti elimiä, jotka saattaisivat olla vastuussa asian aktiivisesta edistämisestä.

Asiasanat (avainsanat)
Ympäristönsuojelu, päästöt, päästömittaukset, päästömittausten harmonisointi, mittausstandardit, meriensuojelu, ilmansuojelu, kansainvälinen ympäristöoikeus, taloudelliset ohjauskeinot, kansainväliset sopimukset, ympäristömerkinnät

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Resultat av utsläppsmätningar utnyttjas på många sätt i internationella och nationella sammanhang. Av användningsområden kan det nämnas uppföljning av iakttagandet av internationella miljökonventioner, miljöstatistik samt olika ekonomiska redskap, såsom miljömärkningar och EMAS.

Denna publikation är delvis en fortsättning på en tidigare utredning som utgivits som nummer 581 i Vatten- och miljöstyrelsens duplikatserie.

Denna rapport beskriver kort behovet och viktigheten av att harmonisera utsläppsmätningarna.

Slutligen understryker rapporten behovet och viktigheten av åtgärden som behövs inom området samt uppräknar som exempel olika organ som kunde ta ansvaret för att aktivt driva saken vidare.

Sakord (nyckelord)
Miljöskydd, utsläpp, utsläppsmätningar, harmonisering av utsläppsmätningar, mätningsstandarder, havsskydd, luftvård, internationell miljörätt, ekonomiska redskap, internationella konventioner, miljömärkningar

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EXECUTIVE SUMMARY

This report is intended to give a short illustration of the importance and need for the harmonization of pollution emission measurements. These emission measurements are carried out by different methods in different countries and as a consequence of this, the environmental data is not comparable internationally.

It is pointed out that not only the use of standardized analysis methods but also many other aspects (such as sampling, pretreatment of samples etc.) in the procedures of producing emission data is of utmost importance. However, the other elements are mostly ignored or standardized only nationally.

The new international environmental policy instruments, eco-labels, the Eco-management and Audit Scheme (EMAS) Regulation, environmental impact assessment (EIA) Directive etc. may suffer in credibility if the consumers and clients cannot trust the basic data used in the public information or behind the public figures.

The multinational conventions dealing with marine or air pollution have features which are in connection with emission or discharge measurements; and mainly without any harmonized methodologies of emission measurements.

In the EU legislation dealing with pollution prevention this problem has been noted already e.g. in 89/427/EEC (amendment of 80/779/EEC), *Air quality limit values*, by stating that "... it is essential to harmonize the measurement methods..." and in 88/609/EEC, *Large combustion plants*, that "... the Commission... shall present proposals to the Council aiming at harmonizing emission inventory methodologies..."

As conclusion, the report stresses the importance and need for actions to be taken in the field, and lists as examples bodies such as European Union (EU), European Environment Agency (EEA), Statistical Office of the European Union (EUROSTAT), Organization for Economic Cooperation and Development (OECD) etc. that may be responsible for taking active role or steps forward in the matter.

TO THE READER

A special working group established by the Finnish National Board of Waters and the Environment conducted in 1993—94 a survey of the essential features of the discharge (emission) measuring practices in different countries. Countries included in the survey were Germany, the Netherlands, Sweden and Canada; a comparison with the situation in Finland was part of the work. The survey showed that there is an evident need for international harmonization of emission measurements.

This matter has been discussed in the Consultative Committee for Environmental Standardization of the Finnish Standards Association (SFS). On the basis of these discussions, SFS took an initiative in European Standardization Organization (CEN) and its Programming Committee PC 7 (Environment). The Finnish proposal was that CEN/PC7 should make a recommendation to establish an *ad hoc* group:

> a) to study the present situation and the need for further standardization in the field of emission measurements; and
>
> b) to study the role of harmonization of emission measurements in the ongoing standardization related to environmental performance evaluation, environmental labelling etc.

In the PC 7 meeting in June 1994, Brussels, a recommendation was made to combine the initiative of the Finnish Standards Association (PC 7 N 38, *Harmonization of Emission Measurements*) and the proposal of Danish Standard Association (DS) (PC 7 N 51, 1994-06-13, report *Pollution Control Methods and Equipment*) to be handled by the same *ad hoc* group (*vide* PC 7 Recommendation 18/1994).

A project, financed by Ministry of the Environment, Ministry of Trade and Industry, and Finnish Forest Industries Federation, was established and carried out by the Finnish Environment Agency (former National Board of Waters and the Environment) in order to study the need of such harmonization. The project commenced in September 1994 and came to an end in May 1995. This paper is the report of that project.

The project has been lead by a steering group:

Mr. Hannu Nilsen, United Paper Mills Ltd. (chairman),
Ms. Erja Fagerlund, Ministry of Trade and Industry,
Ms. Kirsti Haapala, Finnish Environment Agency,
Mr. Pertti Heinonen, Finnish Environment Agency,
Mr. Markku Hietamäki, Ministry of the Environment,
Ms. Marianne Kaplas, Statistics Finland,
Ms. Anja Laukkarinen, VTT Chemical Technology,
Ms. Pirkko Molkentin-Matilainen, Finnish Forest Industries Federation, and
Ms. Susanna Vahtila, Finnish Standards Association.

I want to thank all the persons whom I have had the possibility to talk with while writing and preparing this publication, especially the chairman and the members of the steering group and all the persons whom I have interviewed (list of persons and institutions/companies in the Annex). I also received a lot of help concerning international conventions from Ms. Vappu Tervo and Mr. Julius Lassig, the Ministry

of the Environment. Mr. Martti Koskenniemi's (University of Helsinki) contribution is appreciated. Mr. Yrjö Mäkelä (Finnish Forest Industries Federation) contributed essentially to the contents of paragraph 2.3 (Ecolabels). Mrs. Marianne Saari checked the English and Miss Mari Voipio the Swedish. Ms. Pirjo Lehtovaara helped essentially in completing the word processing.

Helsinki, May 1995

Jari J. Marjanen

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1 INTRODUCTION

Increasing worry of the state of our common environment and its ability to stand under the pressure coming from economic and population growth has lead to evaluation of national and international environment policy and to nascence of new environmental-aware generation. Clean environment and pro-environmentality of economic actions has become an object of competition. The goal of every state is to succeed well in international comparisons concerning environmental burdens, in boundaries set by the state's own capability. The consumers and clients are interested in taking the environmental impacts of a product into account when making their purchase decisions. Therefore the industry has responded to the demands of consumers and brought into use a new marketing approach, pro-environmentality.

Bad results in pro-environmentality competition may lead to decreased competitiveness of an individual enterprise or field of business, even world-wide. Fair and equal competition between the results of the environmental policy of different countries and the pro-environmentality of production and products, also recalling the attitudes of an environmentally aware consumer, would require uniform evaluation methods for environmental burdens. However, the methods used at present, are very non-uniform on national and especially international level.

The survey published earlier in Mimeograph Series of the National Board of Waters and the Environment No. 581 revealed that the discharge permit, control and measurement practices are quite different in the countries that were studied. An important explanation to these differences is the fact that the national environmental legislations differ substantially and the rules and regulations concerning the control and monitoring of emissions also show discrepancies in their structure and comprehensiveness. The comparison of control systems is a difficult task due to the complexity of the systems. In federal countries the regional states have issued their own control regulations.

It became evident that legislation, orders and regulations do not give a fully reliable picture of emission monitoring. Measuring practices and routines may significantly differ from the regulations in force. Visits to factories and plants (especially pulp and paper plants) were a part of the preliminary project.

As a rule, emission data are not publicly available in Europe. The total averages of countries are known but it is not known how emission inventories have been made in individual plants.

National analysis method standards are used. However, the national standards are usually based on international standards. In the preliminary project there were no possibilities to compare those national methods. It was apparent that there are problems with some standards, such as the coverage (sampling, pretreatment of samples etc.) and therefore the reliability of the results may suffer.

In all countries concerned, rather little importance has obviously been attached to calculation methods of emissions. This is a problem when e.g. one counts emission amounts per time unit using concentrations and discharges. Calculation methods may essentially conduce to the results.

The purpose of this project is to study the needs and possibilities for the harmonization of emission measurements in different European connections, e.g. in environmental protection, emission charges and foreign trade.

A decision was made to interview representatives of certain branches of industry: pulp and paper industry, metal industry, chemical industry, and energy production. E.g. traffic (transport), agriculture and waste management were excluded. Several persons from different companies and institutions have been interviewed (for details *vide* the Annex). Both the earlier project and the interviews prove that differences in measurements and the presentation of data make comparisons difficult and even impossible.

In regard to the relevant comparisons, agreements or directives, etc. it is of utmost significance that the definitions of emission values are defined in the same way in each field to be compared. E.g. the following aspects are essential:

1) purpose of the measurement
2) coverage of examination
3) representativeness of the sample
4) pretreatment and storage of the sample
   e.g. BOD and COD measurements: filtered/non-filtered, homogenised /non-homogenised samples
5) use of standard analysis methods
6) conformity of the calculation methods of the results
7) reporting of the results.

As an example in coverage of examination, the definitions are very important (e.g. sulphur emissions from pulp mills — all the emissions must be included, TRS-emissions + SO_2 emissions).

In several connections (eco-labels, LCA, bilateral and multilateral agreements etc.) comparisons and reports on emissions are made. Reporting, publishing, statistical comparison and use of the emission data differ from one country to another.

2 EMISSION DATA IN ENVIRONMENTAL PROTECTION

2.1 Use of emission data in environmental protection in Finland

Emission[1] data are used in Finland e.g. in water courts according to the Water Act (vesilaki, 264/61) and in regional environment centres according to the Environmental

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1 The concept of emission, in Latin *emissio*, has been derived from the Latin *emittere* (< ex + mittere), which means 'to send out'. The concept of immission, in Latin *immissio*, has been derived from the Latin *immittere* (< in + mittere) which means 'to send in'. Both concepts have been used in Roman law, Corpus Iuris Civilis. Emission means some substance, noise etc. from a car, chimney of an industrial plant etc. Immission refers to impurity concentration which can be measured at some measuring point, independent on where the impurity came from. — Immission measurements are not discussed in this paper.

Permit Procedures Act (ympäristölupamenettelylaki, 735/91). Permits to small plants are issued by municipal authorities.

The environmental permits given by the appropriate authorities usually include orders to provide the authority/authorities with the emission data of the plant concerned on a regular basis.

Emission data are also collected nationally by the Finnish Environment Agency and regional environmental centres.

2.2 Emission data and environmental policy instruments

In most countries environmental protection is based on administrational guidance, i.e. regulatory measures to control emissions. Alternative types of measures, such as economic instruments, have, however, gained popularity among environmental policy makers.

An *ad hoc* Committee on Economic Instruments for Environmental Protection in Finland classified different types of environmental policy instruments into three categories. The three main types are 1) price-based, 2) quantity-based, and 3) information-based policy measures. The outcome of the use of these measures depends on the overall functioning of the steering system which is presented in Fig. 1 (Committee Report 1989, Ministry of Finance, Finland; with amendments).

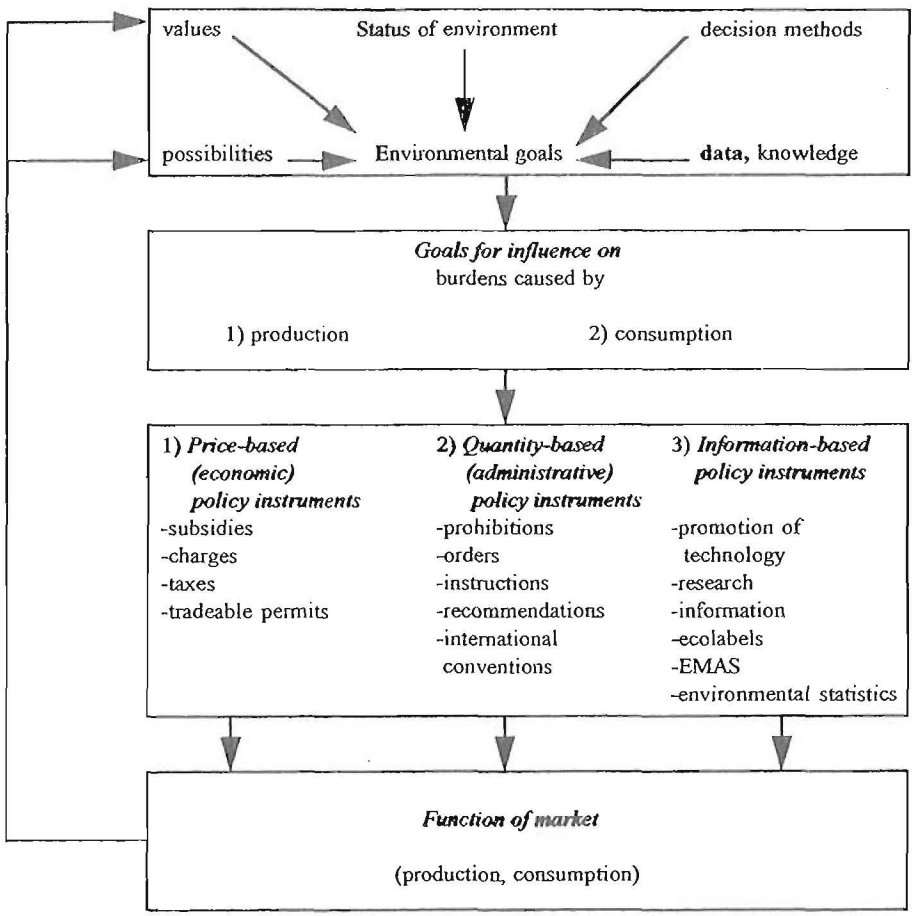

Fig. 1. Environmental policy instruments, chart.

A) Direct control of quantities through regulation

Environmental regulations for controlling emissions are an example of quantity control measures. These are widely applied in different forms all over Europe. These types of measures, while considered the most efficient in many cases, may have limited applicability, for example in cases of large amounts of small pollutants in several sectors. Changes in environmental protection are leading to the increased use of so-called market based instruments, including economic instruments which are based on controlling environmental impacts through the use of price mechanism. The most well-known forms of such measures are taxes and charges, deposit systems and governmental guarantees. Increasing environmental problems, the polluter pays principle and the need to integrate environmental policy with policy, presuppose the use of economic instruments beside the traditional administrative/judicial methods. Even a sharp progressive taxation has been considered in EU countries with a purpose to incite shifting consumption towards less environmentally harmful products.

B) Price effects through economic instruments

The new demands of resorting to the use of economic instruments are based on the need to find new means of internalising environmental costs, i.e. to include in the prices of products the environmental harm caused by the consumption or production phase of the product, not only the costs of investments for controlling emissions to the required level.

Environmental taxes can roughly be divided in two groups: pollution taxes and resource taxes. The aim of pollution taxes is to diminish emissions into the environment and the aim of resource taxes is to diminish the use of some resource, e.g. energy or groundwater.

Selling emission quotas is in use in the USA, especially in the field of air pollution control. An extreme example is the Clean Air Incentives Market in California. (Hoffrén 1994.) Supranational environmental taxes and CO_2 quotas have also been discussed. Tax reliefs, such as those for the purchase of relatively non-polluting motor vehicles, are also an instrument (e.g. Krämer 1992). **Such new environmental measures and pollution taxes require, nevertheless, emission data which should be intercomparable in order to gain practical feasibility and avoid arbitrarities in the tax system.**

Several different economic instruments are used in environmental protection. The instruments in Finland have been rather similar to those used in other European countries; however, Finland introduced fuel taxes for fossil fuels as the very first country in the world.

The fact that environmental values are difficult to assess in monetary terms has been used as an argument against economic instruments in favour of administrational instruments; however, the problems as regards emission measurements are similar in both fields. Economic instruments have been argued to have the advantage that differences between enterprises/manufacturers can more easily be taken into account and they have been argued to be more objective as well (cf. Soininvaara 1993).

The question of emission measurements has not, however, been fully covered in the more economic theory based arguments and discussions, and one could argue for the need of clear measurement rules and practices in the further development of possible practical implementations of the new measures.

C) Information as a policy tool

According to economic theory information is essential in well-founded policy choices. There are several ways of improving the availability and quality of information related to the environment. General types are research activities, the role of non-governmental organisations, market studies and marketing, consumer policies, statistical activities etc. Emission control quality assessment should also be seen as an information-related policy area.

A specific tool, ecolabel, is usually based on a voluntary programme that aims at guiding consumers on how to take environmental considerations into account in the choice of particular products and services. The products are assessed for example in the European ecolabelling programme through a "cradle to grave" approach in order to make a non-biased assessment of the whole life cycle of the product in question. Voluntary product declaration systems may also help consumers in finding relevant information. In the following sections some specific questions related to emission measurements and types of ecolabelling and other information-related environmental instruments are discussed in more detail.

2.3 Emission measurements and environmental labelling

Environmental labelling aims at communicating information on the environmental aspects of products and services to consumers. It is also used in business-to-business occasions when producers wish or are required to provide environmental information on their products. The use of environmental labels is usually voluntary.

Providing information can encourage the demand for and supply of products which are less damaging to the environment and can thereby stimulate a potential for market-driven environmental improvement.[2]

The term environmental labelling can sometimes be misleading since it is quite often associated with so-called traditional eco-labels, i.e. third-party certified exclusive voluntary labels. Nevertheless, environmental labelling should be understood here as a broader concept including the following categories:

- multi-criteria labels
- single-criteria labels
- eco-profiles
- producers' self-declaration claims
- particular symbols

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[2] N.B. Currently the primary objective of environmental labelling is being debated. Sometimes environmental improvement is considered as the primary objective while it is also argued that providing better information should be the primary objective and it can then result in environmental improvement.

Multi and single-criteria labels and eco-profiles are usually third-party certified, i.e. some independent body studies the environmental aspects of the products to be labelled and then decides whether the product in question meets specific requirements and decides whether the applicant can be given the right to use the label.

Both self-declaration claims and symbols are usually self-declarative, i.e. the company willing to use them may decide whether it wishes to use these labels. No third-party certification is needed. Sometimes the use of claims and symbols can also be obligatory depending on the legislative requirements.

The International Organization for Standardization (ISO) has commenced work on preparing standards and specifications in order to foster the international harmonization of the principles of environmental labelling and it is preparing a document that should address the basic principles of all environmental labelling (to become ISO 14020).[3] Other international organisations such as UNEP, UNCTAD, OECD and GATT/WTO have shown a great interest in the matter, too.

The United Nations Environmental Programme UNEP in cooperation with the United Nations Conference on Trade and Development UNCTAD has planned to carry out activities aiming at mutual recognition of national environmental labelling schemes. This could enable a product that has been awarded a label under one labelling programme to receive mutual recognition and occasionally be labelled in other countries on the basis of the criteria it was first granted the label.

Multi-criteria labels

Multi-criteria labelling is usually voluntary and based on a third party certification. These criteria include such parameters as AOX, BOD, share of recycled fibre, etc. At present there are some thirty initiatives worldwide. The schemes are usually national such as the ones in Germany (Blue Angel), Canada (Environmental Choice) and the Netherlands (Milieukeur). They are usually financially backed up by governments. Experience has shown that by this far these types of labelling programmes need constant external financial support.

One of the underlying principles of multi-criteria labelling is that the life-cycle of products should be carefully studied and criteria set on the basis of the findings made. If a product can then meet the criteria, it can be given the right to use the label. The criteria are set so that only a proportion of the competing products, usually expressed as 5 -- 40 %, can qualify for the label. These labels are thus exclusive.

When establishing criteria for environmental labelling schemes, a life-cycle assessment is often carried out. However, a large amount of data as well as some subjective decisions e.g. on the boundaries of the system are needed. **The harmonization of emission measurements plays an increasingly important role here. It becomes even more vital when building up an international scheme where the data has to be comparable from one country to another. Common rules are needed in order to set objective criteria.**

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3 ISO 14020 (in preparation): Environmental labelling — Basic principles for all environmental labelling.

Some of the less developed countries have claimed that LCA approach leads to restrictive trade effects and should be abandoned. However, to forbid the life cycle approach would be very difficult since it is considered to be one of the basic principles of labelling.

There are two international schemes in operation. The older of them is the one used in the Nordic Countries (Finland, Iceland, Norway and Sweden) with the exception of Denmark, which has decided to concentrate its efforts only on the other scheme, i.e. the EU scheme, in which the other Nordic Countries together with the other EU Member States also participate.

Some private organisations also aim at carrying out multi-criteria labelling programmes, e.g. Bra Miljöval of a Swedish environmental non-governmental organisation. The major difference is that the various interest groups such as authorities, industry, commerce, consumers, environmentalists and trade unions are not always consulted during the criteria preparation phase, which in turn is usually the case in the government-run schemes.

Multi-criteria third-party certified labels are referred to as Type I labels within ISO (standard being prepared: ISO 14024).[4]

The producers willing to use eco-labels are often required to provide data which proves that their products meet the criteria. However, this is too often done on an *ad hoc* basis. There are very rarely internationally accepted standards. Producers are instead required to meet national standards or they are allowed to use their own methods. This leads to unfair competition since competing products are compared on the basis of different measurement techniques.

Single-criteria labels

Single-criteria labels normally use only one aspect of the life-cycle of the product as a criterion. This criterion, however, can include several sub-criteria. This is the case in the certification of sustainable forest management, where there are several sub-criteria but as a whole the label looks only at the raw material extraction and not at the full life-cycle of a product (e.g. paper, paperboard, furniture, etc.). If the product meets the requirement, it is usually certified by a third-party, if the producer is willing to have it certified.

An example of this type is the Forest Stewardship Council (FSC) initiative on sustainable forest management. The German Blue Angel also emphasised in its initial phase only some parts of the life cycle whereas it nowadays looks at it in more detail and can be regarded as a multi-criteria label.

ISO has not included single-criteria labels in its work programme but is most likely considering the need to do so in its meeting at the end of June 1995.

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[4] ISO 14024 (in preparation): Environmental labelling — Practitioner programs — Guiding principles, practices and certification procedures of multiple criteria (Type 1) programs.

Eco-profiles

Eco-profiles are used to gather individual claims into a set of claims representing the various environmental aspects of a product's life-cycle. They are different from the multi-criteria labels described above in the sense that they intend to give information on the products' environmental aspects but not to value them which is the case in the exclusive multi-criteria labelling schemes where the information is given in the form of a one single logo and the purchasers are expected to rely on the judgement made by the third-party certifier.

Eco-profiles are not exclusive since they only give information and let the purchaser make his/her own purchasing decision on the basis of the information he/she receives on the label.

The Netherlands is considering a voluntary approach including an agreement between authorities and some industry sectors. Several seminars, both national and international, have also been held on the subject.

Eco-profiles are called Type III labels within ISO. A US private third party certification scheme for eco-profiles has been studied there. At the end of June 1995 it will be discussed whether ISO should start a standardization activity on eco-profiles.

For both the consumers and international trade the situation may become more and more difficult in the future as the emerging eco-profiles can become difficult to compare. The comparability of emission measurements plays an especially important role.

Producers' self-declaration environmental claims and symbols

Self-declaration labelling is an example of the types of labels that take the most diversified forms. Examples of this type are e.g. claims that a product can be recyclable, refillable, compostable etc. These claims can be in a form of a symbol but they also can stand alone as single statements.

The International Chamber of Commerce (ICC) has prepared guidelines on environmental marketing. They do not, however, go as far as including recommendations for harmonized test methods where these do not exist. In addition, certain consumer authorities have issued national guidelines concerning the use of environmental attributes in marketing.

Within the ISO, harmonized specifications are being prepared for particular claims (to become **ISO 14021**).[5] ISO is also preparing specifications for symbols (ISO 14022). It will also prepare specifications on testing and verification methodologies

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5 ISO 14021 (in preparation): Environmental labelling — Self declaration environmental claims — Terms and definitions.

(to become **ISO 14023**).[6] **The harmonization of emission measurements should play an important role there, too.**

The EU Packaging Directive has provisions on the marking and identification of packaging, even if these provisions do not include emission data. **The Directive further states that the Commission shall promote the preparation of European standards relating to criteria and methodologies** for life-cycle analysis of packaging, methods for measuring and verifying the presence of heavy metals and other dangerous substances in the packaging and their release into the environment from packaging and packaging waste, criteria for a minimum content of recycled material in packaging for appropriate types of packaging, criteria for recycling methods, criteria for composting methods and produced compost and criteria for marking of packaging. **Special attention should be paid to the comparability of measurements when carrying out these activities.**

Final remark

Lack of clear standards may in the future be considered as a barrier to trade especially by the developing countries. It may also cause difficulties in the reliability of the schemes in the eyes of consumers. Within the European market, the small and medium-sized enterprises may find it extremely difficult to implement several practices to produce emission data for various environmental labelling purposes.

2.4 The EMAS Regulation (1836/93/EEC)

Industrial companies can participate in the voluntary Eco-management and audit scheme (EMAS) system from April 1995. The objective of the scheme is to promote continuous improvements in the environmental performance of industrial activities.

A public environmental statement is an essential part of the EMAS Regulation. The statement is to contain information on for example relevant emissions. **The contents of environmental statements** in different branches or countries might, however, **be seriously improved in terms of comparability of data, with clear emission measurement practices** across industrial process types, branches and sites.

According to the regulation, the statement shall be designed for the public and written in concise, comprehensible form; technical material may be appended. The statement shall include, among other things, in particular an assessment of all the significant environmental issues of relevance to the activities concerned and a summary of the figures on pollutant emissions, waste generation, consumption of raw material, energy and water, noise and other significant environmental aspects.

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6 ISO 14022 (in preparation): Environmental labelling — Self declaration environmental claims — Symbols.
ISO 14023 (in preparation): Environmental labelling — Self declaration environmental claims — Testing and verification methodologies.

The overall credibility of this new European market based environmental policy instrument might be improved by guidelines on the way emission data should be produced on the European sites. This in its turn would enhance the use of this voluntary mechanism and increase the consumer and client trust in the scheme.

2.5 The EIA directive

The Environmental Impact Assessment (EIA) helps making preparations for decision making, and its result does not define the contents of a permit licence.

The developer (i.e. the applicant for the authorization of a private project or the public authority which initiates a project) shall provide information of the project in question. According to Annex III of the directive, the description of the project must include an estimate, by type and quantity, of expected residues and emissions such as water, air and soil pollution, noise, vibration etc. resulting from the operation of the proposed project.

Since the **EIA Directive** is of general nature (and the practical details of the method used are mainly dependant on local practices) it **does not include any specified technical details or references to standards. However, the comparability of different assessment applications or the development of new impact assessment methods and indicators might be best helped by resorting to well established harmonized methods of producing estimates for base emission data.**

2.6 Environmental statistics

The purpose of environmental statistics is to produce information for the needs of political and administrative decision making, educational circles and specialists as well as for the general public. They are also used in the measurement of environmental performance and the evaluation of how well governments are succeeding in their efforts to implement their domestic policies and international commitments.

Reliable, nationally and internationally comparable data should be produced for these ends. **However, classifications, definitions and measurement methods differ from one country to the other, which constitutes a problem in international statistics and comparisons.** When there are no common definitions and classifications the way of expressing data must be carefully pondered. Environmental statistics usually express trends and changes. Therefore they are used in following international conventions and national targets.

The assessment of environmental performance is often hampered by the lack of comparable data. In many countries, the systematic collection of environmental data has only a short history; sources are typically spread across a range of agencies through levels of government. Information is collected partly for other than licence follow-up purposes. **The lack of agreement on the analytical measurement procedures, or on the definition of descriptive criteria, or, because of the variations in the frequency of measurements or data collection have lead to problems in comparing environmental data.** Such difficulties have arisen because of the driving force for gathering environmental information has been the need to deal with specific,

often local, problems rather than the need to produce co-ordinated integrated data sets.

Efforts are being made to develop standardised international classifications for environmental data. Global Environmental Monitoring System (GEMS) has been working with ca 142 countries in one or more activities in order to help to standardize working methods, data handling and assessment procedures.

The UNEP/GEMS Harmonization of Environmental Measurements Centre (HEM), established in 1989, has been developed to assist this process. Other organisations active in this field include the ISO, and CEN which provides information on analytical measurement techniques and CODATA, which deals with the compilation, critical evaluation and management of data of relevance to science and technology.

3 MULTINATIONAL CONVENTIONS

3.1 Water and marine pollution control

The water and marine pollution control agreements and conventions discussed here (including the most essential amendments) have been listed in Literature.

Pollution sources of the marine environment can be divided into four groups:

- pollution from the shore, either directly or indirectly
- pollution from ships
- pollution from waste dumping
- pollution caused by research and use of sea bottom.

Pollution from ships and aircraft or caused by research and use of sea bottom is not discussed in this paper.

Multinational conventions contain several types of regulating protection of the marine environment: absolute prohibitions, emission restrictions, technical norms, and permit arrangements.

We can remark that the Convention of North-East Atlantic and HELCOM 1992 are "modern": they e.g. define the concepts of BAT and BEP. **All the conventions in question have at least some features which are in connection with emission and discharge measurements.**

3.1.1 The PARCOM Convention

The first session of the conference on marine pollution from land-based sources was held in Paris in 1973 at France's initiative. The purpose of this conference to put together regulations for an important sector of marine pollution which was not yet covered by any international conventions, namely, pollution brought into sea by rivers, estuaries, and pipelines, as well as by direct discharges into the sea from the shore. (Johnson and Corcelle 1989). Finland is an observer in PARCOM.

According to the Paris Convention (PARCOM) the contracting parties undertake to eliminate, if necessary by stages, pollution from land-based sources by substances listed in the convention (Annex A, Part I, e.g. organohalogen compounds, Hg and its compounds and Cd with its compounds) and to strictly limit pollution from land-based sources by other substances also listed in the convention (organic compounds of P, Si and Sn, elemental P, As, Cr, Co, Pb, Ni, Zn etc.).

In preserving and enhancing the quality of the marine environment, the contracting parties shall, *inter alia*, take account of (a) **the nature and quantities of the pollutants** under consideration and (b) **the level of existing pollution. These both are connected with emission measurements.**

There are also decisions and recommendations by PARCOM. The Commission recalled at its Ninth Meeting (1987) that all PARCOM Decisions are legally binding and have to be implemented by the Contracting Parties in the national legislation. Because of the large number of decisions and recommendations, they cannot be presented in detail in this paper, but there are detailed requirements for measurements in several of them.

3.1.2 Convention of the North-East Atlantic (OSPAR)

This convention, when it comes to force, will replace the Paris convention (1974). It prohibits dumping with certain exceptions.

The contracting parties shall apply the precautionary principle and the *polluter pays* principle. This convention, too, contains definitions of BAT and BEP. BAT "means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be given to (a) comparable processes, facilities or methods of operation which have recently been successfully tried out; (b) technological advances and changes in scientific knowledge and understanding; (c) the economic feasibility of such techniques; (d) time limits for installation in both new and existing plants; and (e) the nature and volume of the discharges and emissions concerned. It therefore follows that what is BAT for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding. If the reduction of discharges and emissions resulting from the use of BAT does not lead to environmentally acceptable results, additional measures have to be applied."

BEP "means the application of the most appropriate combination of environmental control measures and strategies. In making a selection in individual cases, at least the following graduated range of measures should be considered: (a) the provision of information and education to the public and to users about the environmental consequences of choice of particular activities and choice of products, their use and ultimate disposal; (b) the development and application of codes of good environmental practice which covers all aspects of the activity in the product's life; -----; (i) establishing a system of licensing, involving a range of restrictions or a ban. -----
It therefore follows that BEP for a particular source will change with time in the light

of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding."

According to Art. 1 in Annex I, *On the Prevention and Elimination of Pollution from Land-based Sources*, "when adopting programmes and measures programmes and measures for the purpose of this Annex, the Contracting Parties shall require, either individually or jointly, the use of BAT for point sources and BEP for point and diffuse sources."

When regarding this convention as a whole, we can see that it is a "modern" convention which includes several of the latest environmental principles.

In principle, also recommendations and decisions made in virtue of the Paris Convention and Oslo Convention, bind the parties of the OSPAR Convention legally.

3.1.3 The HELCOM Conventions (1974 and 1992)

"The Baltic Sea Area" is the Baltic Sea proper with the Gulf of Bothnia, the Gulf of Finland and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57° 44.8' N. The convention was made at Finland's initiative and it was the very first integrated marine environment protection convention; dumping includes incineration of waste on the sea (Kohonen 1994). The original convention did not include internal waters.

In this paper, we concentrate on HELCOM 1992.

The new convention of the Baltic Sea has been signed in Helsinki on 9 April 1992 but the convention has not come to force yet. In Finland, the new Marine Protection Act (merensuojelulaki, 1415/94; contains the concept of BAT) and amendments of the Water Act (vesilaki) make ratifying of HELCOM 1992 and also the Convention of the North-East Atlantic possible.

The new convention incorporates modernised language; certain new terms were adopted for the purpose of adopting the principles that these terms represent (Koskenniemi 1993). These include the precautionary principle, BEP, and BAT. The parties agree to promote the use of BEP and BAT. Art. 6 requires that BEP be used for all pollution sources and BAT for point pollution sources. The new convention requires contracting parties to notify the Commission and "any potentially affected party" whenever a duty exists for the contracting party to provide an EIA of a proposed activity.

The concepts BEP — which is used to clarify the content of the state's *pater familias* obligation (Koskenniemi 1993) — and BAT are defined in Annex II. The term BEP is taken to "mean the application of the most appropriate combination of measures". The term BAT is taken to "mean the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges". Choosing the method is, as such, a subject of free choice.

Regulation 3, *Principles for issuing permits for industrial plants*, defines the principles and procedures to be followed when issuing the permits referred to in Art. 6 (3)

(pollution from land-based sources). The appropriate national authority issues the permit after comprehensive assessment with special consideration of the above mentioned aspects. *Inter alia*, at least the following shall be laid down in the permit: limit values for amount and quality (load and/or concentration) of direct and indirect discharges and emissions and instructions concerning: type and extent of control to be performed by the operator (self-control) and analytical methods to be used.

The appropriate national authority or an independent institution authorized by the appropriate national authority shall inspect the amount and quality of discharges and/or emissions by sampling and analysing.

In newer recommendations there are references to measuring methods. This is a good sign of positive development. Recommendations do not cover all the industrial sectors and it is too early to draw broad conclusions, how these efforts increase the international comparability of emission data.

3.2 Air pollution control

The air pollution control agreements and conventions discussed here have been listed in Literature/References (including the most essential amendments). The air pollution control conventions are newer than marine pollution control conventions. All the conventions have references to emission control. **The "Sulphur Protocol" and "NO_x Protocol" refer to models, basis of calculations and even explicitly to harmonized methodologies of emission inventories.**

3.2.1 Convention on Long-range Transboundary Air Pollution (The 1979 Geneva Convention) and Protocols

The Geneva Convention basically represents a general framework convention. It is the cornerstone of international sulphur and nitrogen policy. The convention itself is of general nature but the "Sulphur Protocol" (Helsinki 1985) and the "NO_x Protocol" (Sofia 1988) make it more concrete. (Johnson and Corcelle 1988; Kuusiniemi 1994.) The protocols include concrete emission level targets and in order to reach the levels the parties must take measures for the management and monitoring of air pollution, in particular by using the "best available technology which is economically feasible and low- and non-waste technology" (≈ BATNEEC).

The Contracting Parties shall initiate and co-operate in the conduct of research into and/or development of: a) existing and proposed technologies for reducing emissions of sulphur compounds and other major air pollutants, including technical and economic feasibility and environmental consequences; b) instrumentation and other techniques for monitoring and measuring emission rates and ambient concentrations of air pollutants ---".

According to Art. 8, *Exchange of information*, the Contracting Parties shall "exchange available information on a) data on emission at periods of time to be agreed upon, of agreed air pollutants, starting with sulphur dioxide ---" According to Art. 9, Implementation and further development of the co-operative programme for the monitoring and evaluation of the long-range transmission of air pollutants in Europe, the Contracting Parties stress the importance of EMEP "and, with regard to the further

development of this programme, agree to emphasize: --- **b) the need to use comparable or standardized procedures for monitoring whenever possible** ---"

The "Sulphur Protocol" is an agreement on the reduction of sulphur emissions or their transboundary fluxes by at least 30 per cent. Each Party shall provide annually to the Executive Body its levels of national annual sulphur emissions, and the basis upon which they have been calculated. Art. 5 sets an obligation to the EMEP to provide the Executive Body with calculations of sulphur budgets and also of transboundary fluxes and depositions of sulphur compounds for each previous year within the geographical scope of EMEP, utilizing appropriate models".

The "NO_x Protocol", among other things, sets the parties an obligation to apply national emission standards to major new stationary sources and/or source categories and to substantially modified stationary sources in major source categories, based on the best available technologies which are economically feasible and to introduce pollution control measures for major existing stationary sources. According to Art. 6, *Work to be undertaken*, the Parties shall, among other things, "seek to: --- (c) **Develop measurements and model calculations including harmonized methodologies for the calculation of emissions**, to quantify the long-range transport of nitrogen oxides and related pollutants; ---" The Parties shall exchange information by notifying the Executive Body of the national programmes, policies and strategies that they develop, and in particular on (*inter alia*) the levels of national annual emissions of nitrogen oxides and the basis upon which they have been calculated.

The Protocol also contains a Technical Annex which is recommendatory in character. The Annex mainly deals with control technologies for emissions from motor vehicles; however, according to it for stationary sources, emission factors are expressed in milligrams of NO_2 per normal (0 °C, 1013 mb) cubic metre (mg/m^3), dry basis.

Thus **this convention requires comparability and development of standard methods**. The "Sulphur Protocol" requires expressing basis upon which annual sulphur emissions have been calculated. Article 6 (c) in the "**NO_x Protocol**" **explicitly mentions harmonized methodologies**.

3.2.2 The Vienna Convention and the Montreal Protocol

Following the preparatory work carried out in 1981 under UNEP, this convention designed to protect the ozone layer of the stratosphere was adopted in Vienna in 1985. The Vienna Convention, too, can be considered to be a framework convention, since its provisions are of very general nature. (Johnson and Corcelle 1989.)

Annex II in the Vienna Convention, *Information Exchange*, defines the emission data needed for research as part of the information to be exchanged. The Montreal Protocol (16 September 1987, several amendments) contains a list of (specially) controlled substances; this list has been replaced with amendments made in Copenhagen 25 November 1992. According to the 6th preambular paragraph (amended in London 29 June 1990) the parties "have determined to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination ---" and the 9th paragraph (the same amendment) "considering the importance of promoting international co-operation in the research, development and transfer of alternative

technologies relating to the control and reduction of emissions of substances that deplete the ozone layer --".

The goal of the Montreal Protocol and its amendments is to decrease and finally stop the consumption of certain ozone-depleting substances. Under the terms of the Protocol the parties are required to submit data concerning their levels of consumption, production and trade of these substances, therefore **no references to measurement methods or standards are mentioned.**

3.2.3 UN Framework Convention on Climate Change

In the preamble of this convention there is a reference to the Vienna Convention and the Montreal Protocol. In this very convention the term emissions "means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time".

All Parties shall: (a) Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of all greenhouse gases not controlled by the Montreal Protocol, **using comparable methodologies to be agreed upon by the Conference of the Parties**. Paragraph 2, subparagraph (b) in the same Article states: "In order to promote progress to this end, each of these Parties shall communicate within six months of the entry into force of the Convention for it and periodically thereafter, and in accordance with Article 12, detailed information on its policies and measures referred in subparagraph (a) above, as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol ---" Subparagraph (c) states: "Calculations of emissions by sources and removals by sinks of greenhouse gases for the purposes of subparagraph (b) above should take into account the best available scientific knowledge, including of the effective capacity of sinks and the respective contributions of such gases to climate change. **The Conference of the Parties shall consider and agree on methodologies for these calculations at its first session and review them regularly thereafter.**"

The need for standard methodology for compiling national greenhouse gas emission inventories was obvious already by the time of the Second World Climate Conference in Geneva in 1990. **International Panel for Climate Change (IPCC) initiated to develop the harmonized method for calculation of the greenhouse gas emissions.** The Greenhouse Inventory Workbook, IPCC Draft Guidelines for National Greenhouse Gas Inventories was published in 1993. The work was done in cooperation with the OECD and the International Energy Agency (IEA) and the support from the USA, the UK, and Norway.

It can be noticed that the obligations in this convention, e.g. monitoring and comparability, require harmonization of emission measurements.

4 EU AND EMISSION MEASUREMENTS

4.1 General about environmental EU legislation

In water pollution control, the role of fixed standards has (for a long time past) been essential in Continental Europe, unlike in Britain and the Nordic Countries (Vihervuori 1992); e.g. here in Finland the Water Courts typically set emission/discharge norms case by case. Water pollution policy is the oldest and also the most complete sector of EU/EC/EEC environment policy, which reflects the historical situation in most (old) member states, where problems of water pollution have been dominant both internally and externally (Johnson and Corcelle 1989).

According to Bennett (1991) the EU legislation concerning the control of air pollution falls into six broad categories:

- air quality (SO_2, particulates, Pb and NO_x)
- emissions from industrial plants
- information and monitoring (incl. exchange of monitoring data)
- atmospheric change
- product standards for fuels — not discussed in this paper
- product standards for vehicles — not discussed in this paper.

4.2 About relevant individual regulations and directives

4.2.1 Directive 76/464/EEC: Dangerous substances into water

This directive is the framework directive concerning emissions/discharges into the aquatic environment. The directive applies to inland surface water, territorial waters, internal coastal waters and ground water. — Please note that in this directive the term "emission standard" means permit regulations, not general limit values (Vihervuori 1992).

The dangerous substances are divided in two groups, the so called "black list" and the "grey list" (Annex). The "daughter directives" set limit values to discharges for some substances mentioned in the "black list" - which means that the other substances in the "black list" actually belong to the "grey list". The permit control also covers discharges of the "black list" substances into sewers. Member states shall apply a system of zero-emission to discharges into ground water of substances within the "black list".

The list I substances are (1) organohalogen compounds and substances which may form such compounds in the aquatic environment, (2) organophosphorus compounds, (3) organotin compounds, (4) carcinogenic substances, (5) Hg and its compounds, (6) Cd and its compounds, (7) persistent mineral oils and hydrocarbons of petroleum origin, and (8) "persistent synthetic substances which may float, remain in suspension or sink and which may interfere with any use of the waters".

Even though the term 'emission standards' is used in this directive, this directive contains no references to analysis methods or international/European/national standards.

4.2.2 Directive 80/68/EEC: Protection of groundwater

This directive is a "daughter directive" of 76/464/EEC. This directive also contains two lists; member states shall take the necessary steps to (a) prevent the introduction into groundwater of substances in list I and (b) limit the introduction into groundwater of substances in list II so as to avoid pollution of this water by these substances. The member states shall prohibit all direct discharge of substances in list I. The lists in Annex and lists in the Annex of 76/464/EEC are practically identical.

According to Art. 9, "when direct discharge is authorized in accordance with Art. 4 (2) and (3) or Art. 5, or when waste water disposal which inevitably causes indirect discharge is authorized in accordance with Art. 5, the authorization shall specify in particular:

- the place of discharge
- the method of discharge
- essential precautions etc.
- the maximum quantity of a substance permissible in an effluent during one or more specified periods of time and the appropriate requirements as to the concentration of these substances
- the arrangements enabling effluents discharged into groundwater to be monitored
- if necessary, measures for monitoring groundwater, and in particular its quality."

Art. 10 deals with cases "when disposal or tipping for the purpose of disposal which might lead to indirect discharge is authorized in accordance with Articles 4 or 5." This article resembles, as a whole, Art. 9. According to it, authorization shall specify in particular the maximum quantity permissible, during one or more specified periods of time, of the matter containing substances in lists I or II and, where possible, of those substances themselves, to be tipped or disposed of and the appropriate requirements as to the concentration of those substances.

This directive does *not* contain, nevertheless, any references to analysis methods or any standards.

4.2.3 Directive 80/779/EEC and its amendment 89/427/EEC: Air quality

This Directive is the first EU directive dealing with air quality and it has been a model for the other air quality directives; therefore the air quality directives are rather similar and may even contain same articles (Marttinen 1992). The directive was the first piece of Community-wide legislation to lay down mandatory air quality standards and the directive foresees member states setting more stringent standards in zones needing special environmental protection (Bennett 1991). An important part of the directive is the "standstill principle": air quality was not to be allowed to deteriorate significantly, even in areas where pollution is well below the limit values (Bennett 1991; cf. Marttinen 1992).

The preamble states: "--- **Since different sampling and analysis methods are applied in the Member States**, it is necessary to permit, under certain conditions, the use of sampling and measurement methods other than the reference methods laid down in the Directive" and "since some Member States use particular methods of

sampling and analysis which cannot easily be correlated with the reference methods, it is necessary that the Directive specify different limit values which are to be respected where such methods are used; whereas the Member States concerned should also carry out parallel measurements at a series of representative stations using the reference methods in addition to their own methods of measurement; whereas the Commission must make further proposals in the light of these parallel measurements and of the need to avoid discriminatory provisions". The last paragraph of the preamble states that "the subsequent development of reference methods of sampling and analysis referred to in this Directive may be desirable in the light of technical and scientific progress in this area".

The original directive set (Annex I) limit values for the ground-level concentration of SO_2 and suspended particulates (smoke), which were to be met from 1st April 1993. The limit values were given in $\mu g/m^3$.

This directive was amended in June 1989 (89/427/EEC) because "the results of the parallel measurements have shown that the limit values set out in Annex I and Annex IV to this Directive do not correspond as regards their stringency", because "some Member States apply the limit values in Annex I and others those in Annex IV" and "this has led to **the use of different methods of sampling which are difficult to compare**" and therefore "**it is essential to harmonize the measurement methods and whereas, therefore, reference methods of technical specifications for the analysis and sampling of sulphur dioxide and suspended particulates in the air must be defined and finalized**". *Nota bene* the following paragraphs: "the dual approach for measuring suspended particulates in the air causes discrimination between Member States" and "whereas a two-stage review is needed to draft proposals to avoid this dual approach without calling into question completion of the measures already taken by the Member States to observe the limit values".

After the amendment, art. 10 (1) is as follows:
"For the purposes of applying this Directive, Member States shall use either the reference methods of sampling and analysis referred to in Annex III for sulphur dioxide and for suspended particulates measured by the black smoke method or in Annex IV for suspended particulates measured by the gravimetric method, or any other method of sampling and analysis in respect of which they demonstrate to the Commission at regular intervals:

- either that it ensures satisfactory correlation of results with those obtained using the reference method,
- or that measurements taken in parallel with the reference method at a series of representative stations chosen in accordance with the requirements laid down in Article 6 show that there is a reasonably stable relationship between the results obtained using that method and those obtained using the reference method."

According to Annex III, the reference method of sampling for the determination of SO_2 uses the equipment described in International Standard ISO-4219 [7] (1st edition 1979-09-15); the sampling period is normally 24 h. The reference method of analysis is described in detail in Annex V; it is based on DIS ISO DP-6767 (revised

[7] ISO 4219-1979: Air quality — Determination of gaseous sulphur compounds in ambient air — Sampling equipment.

February 1979):[8] "Air quality — determination of the mass concentration of sulphur dioxide in ambient air — TCM/pararosaniline" (colorimetric reaction). For suspended particulates, i.e. black smoke and its conversion into gravimetric units, the method standardised by the OECD working party (1964) is considered to be the reference method.

4.2.4 Directive 82/884/EEC: Lead and lead compounds

Lead and lead compounds were defined as first class poisons in the first Environmental Programme of the European Community (Marttinen 1992).

The concentration of Pb in air is not to exceed 2 $\mu g/m^3$, expressed as an annual average mean concentration (from December 1987). Member states may set more stringent values, but the limit value does not apply to occupational exposure. Sampling stations are to be installed and operated at the places, where individuals may be exposed continually for a long period and where there is a possibility that the limit value will not be met. Member states are to supply the Commission, at its request, with information on the sampling sites and sampling and analysis procedures.

The Annex **sets out** how to choose **the sampling method and also a reference method of analysis.** If member states use some other method of analysis, they must prove to the Commission beforehand that it will produce equivalent results. According to the Annex the atmospheric particles shall be collected on the filter of a sample for subsequent determination of lead content. Part A of the Annex, "Characteristics to be complied with for choosing the sampling method" sets demands on (1) filter, (2) minimum acceptable efficiencies (%) for a sampler, (3) aspiration flow rate of sampling, (4) location and (5) operation. In operation, sampling must be continuous although breaks of a few minutes each day or week are permissible to enable filters to be changed. An annual mean value will not be considered valid unless sampling has occurred on a minimum of 10 working days/month. The mean annual value is calculated by dividing the sum of the valid daily values by the number of days on which valid values have been obtained. According to Part B, "Reference method of analysis", the method of analysis shall be AAS (limits for allowed analytical errors for the determination have also been set).

4.2.5 Directive 84/360/EEC: Industrial plants

This directive was the first significant EU/EC response to the problem of acid deposition and the death of forests. The operation of certain industrial plants is to be authorized in advance in order to prevent or reduce air pollution (Bennett 1991). It is also a framework directive in that it foresees subsequent daughter directives setting emission limit values. The first of these daughter directives was 88/609/EEC (4.2.9), adopted in 1988.

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[8] At present: ISO 6767-1990: Ambient air — Determination of the mass concentration of sulphur dioxide — Tetrachloromercurate (TCM)/pararosaniline method.

Emission limit values are in this directive defined as "the concentration and/or mass of polluting substances in emissions from plants during a specified period which is not to be exceeded". The most important polluting substances are, according to Annex II:

- SO_2 and other sulphur compounds
- NO_x and other nitrogen compounds
- CO
- organic compounds, particularly hydrocarbons (except CH_4)
- heavy metals and their compounds
- dust, asbestos, glass and mineral fibres
- Cl and its compounds
- F and its compounds.

The directive requires member states to ensure that the operation of certain plants (specified in Annex I) is given prior authorization; such authorization must be considered at the design state. Authorization is also required in the event of substantial alteration. Before issuing an authorization, the competent authority has to be satisfied that the following conditions are met (Art. 4):

(1) all appropriate preventive measures against air pollution have been taken, including BATNEEC;
(2) the use of plant will not cause significant air pollution particularly form the emission of substances referred to in Annex II (see before);
(3) none of the emission limit values applicable will be exceeded; and
(4) all the air quality limit values applicable will be taken into account.

The Council of Ministers is empowered to fix emission limit values based on the BATNEEC and also to **lay down measurement and assessment techniques and methods**. Member states are required to keep up to date with the progress of BAT and to impose conditions accordingly. They are also required to adapt existing plants gradually to the BATNEEC.

Member states shall take the necessary measures to ensure that emissions from plants are determined for the purpose of monitoring compliance with the obligations referred to in Art. 4. The determination methods must be approved by the competent authorities.

4.2.6 Directive 85/203/EEC: Nitrogen dioxide

This directive was not issued until in 1985. On the whole, it resembles much the "Sulphur Dioxide Directive" and the "Lead Directive". Both limit and guide values have been defined for NO_2 in the air. According to this directive as well, member states "may, at any times, fix values more stringent than those laid down in this Directive".

In conformity with the "Sulphur Dioxide Directive", this directive defines both limit values which must not be exceeded throughout the territory of the member states and guide values intended to serve as reference points for the establishment of specific schemes within zones determined by the member states.

In applying the directive, member states **shall use *either* the reference method of analysis referred to in Annex IV *or* any other method of analysis which the Commission has been shown is equivalent to the reference method.** The reference method of analysis in Annex IV is the chemiluminescence method described in ISO standard DIS 7996.[9]

4.2.7 Directive 88/609/EEC: Large combustion plants

This Directive is the first "daughter directive" of Directive 84/360/EEC (4.2.5).

In this directive *emission* means "the discharge of substances from the combustion plant into the air. *Emission limit value* means "the permissible quantity of a substance contained in the waste gases from the combustion plant which may be discharged in the air during a given period; it shall be calculated in terms of mass per volume of the waste gases expressed in $mg/m^3(n)$, assuming an oxygen content by volume in the waste gas of 3 % in the case of liquid and gaseous fuels and 6 % in the case of solid fuels.

This directive has nine annexes. **Annex IX is *Methods of measurement of emissions. Part A* defines procedures for measuring and evaluating emissions from new plants, *part B* determination of total annual emissions of new plants and *part C* determination of the total annual emissions of existing plants. There are no references to standards.**

Part A. *Emissions from new plants*:

> (1) Concentrations of SO_2, dust, NO_x and oxygen shall be measured continuously in the case of new plants with a rated thermal input of more than 300 MW. However, monitoring of *SO_2 and dust* may be confined to discontinuous measurements or other appropriate determination procedures in cases where such measurements or procedures, which must be verified and approved by the competent authorities, may be used to obtain concentration.
>
> (2) In the case of plants which must comply with the desulphurization rates fixed by Art. 5 (2) and (3), the requirements concerning SO_2 emission measurements established under paragraph 1 shall apply. ---
>
> (3) (Requirements concerning the type of fuel used.)
>
> (4) Continuously-operating measuring systems shall be checked at regular intervals in consultation with the competent authorities. The instruments for the measurements of concentrations of SO_2, dust, NO_x and oxygen shall undergo basic calibration and an examination of their operation at appropriate regular intervals. The continuously-operating measuring equipment shall be calibrated in accordance with a reference measuring method approved by the competent authority.

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[9] (At present:) ISO 7996-1985: Ambient air — Determination of the mass concentration of nitrogen oxides — Chemiluminescence method

Part B. *Determination of total annual emissions of new plants*:

> The competent authorities shall obtain determination of the total annual emissions of SO_2 and NO_x. When continuous monitoring is used, the operator of the combustion plant shall add up separately for each pollutant the mass of pollutant emitted each day, on the basis of the volumetric flow rates of waste gases. Where continuous monitoring is not in use, estimates of the total annual emissions shall be determined by the operator on the basis of paragraph A.1 to the satisfaction of the competent authorities.
>
> Member states shall communicate to the Commission the total annual SO_2 and NO_x emissions of new combustion plants at the same time as the communication required under paragraph C.3 concerning the total annual emissions of existing plants.

Part C. *Determination of the total annual emissions of existing plants*

> Member states shall establish, starting in 1990 and for each subsequent year, a complete emission inventory for existing plants covering SO_2 and NO_x on a plant by plant basis for plants above 300 MWth and for refineries and on an overall basis for other combustion plants to which the Directive applies.
>
> The methodology used for these inventories shall be consistent with that used to determine SO_2 and NO_x emissions from combustion plants in 1980.
>
> ---
>
> The Commission shall organize a systematic comparison of such national inventories and, if appropriate, **shall present proposals to the Council aiming at harmonizing emission inventory methodologies** for the needs of an effective implementation of the Directive.

The directive defines different exceptional cases when emission limit values may be exceeded for a while.

4.2.8 IPPC Proposal

Commission Proposal for a Council Directive on integrated pollution prevention and control (IPPC) aims at "providing for measures and procedures to prevent, wherever practicable, or to minimize emissions from industrial installations within the Community, so as to achieve a high level of protection for the environment as a whole". IPPC Proposal is part of the so-called "multi media approach" as an opposite of sectoral environmental control (Marttinen, Saastamoinen and Similä 1994).

This **IPPC Proposal is of general nature; it contains no references to standards and emission measurement techniques so far.**

In the Proposal, *emission* means "(a) a release of a substance, preparation, heat or noise to air or water (an emission to sewer being considered an emission to water); and (b) the deposit, storage or disposal of substances or preparations in or on land which may contribute to or cause pollution". *Emission limit values* means the mass of substances and preparations or the quantity of heat or noise expressed in terms of certain specific parameters, and/or the concentration of substances, which is not to be exceeded under normal operating conditions in emissions from an installation to environmental media during one or more periods of time. The emission limit values shall normally apply at the point where the emissions leave the installation."

The term *BAT* "signifies the latest stage in the development of activities, processes and their methods of operation which indicate the practical suitability of particular techniques as the basis of emission limit values for preventing or, where that is not practicable, minimizing emissions to the environment as a whole, without predetermining any specific technology or other techniques". This concept BAT (as also terms ELV and EQS) is very essential in the IPPC Proposal but the concept has, up to the present, been rather indeterminate; there have also been references to the BAT principle in several very different connections. Because the emissions into the environment shall be evaluated simultaneously, the concept BAT also means best available techniques when all different kinds of emissions are taken into account — e.g. BAT in waste management is perhaps not BAT in air pollution control etc. (Ekroos 1993).[10]

5 CONCLUSIONS AND ACTIONS TO BE TAKEN

The actions of limiting emissions should be effective — including regional, chronological and economic dimensions. For assessing the efficiency of environmental protection measures in different geographical regions and for the allocation of industrial and environment protection investments, definitions of emissions should be based on comparable methods.

For practical reasons, the object of this survey had to be limited. It could, however, be proved that the need to harmonize emission measurements is evident and that attention has been paid to this fact in several quarters even earlier.

Using different environmental policy instruments effectively, fairly and in an esteemed way requires uniform definition methods. One cannot even think that e.g. in comparisons of environmental statistics, controlling emission limitation conventions or product control or in granting ecolabels to products, methods are based on measurements which do not guarantee international comparability of the results.

According to the examples mentioned in the report there is sufficient evidence to demand that severe attention should be paid to the harmonization of measurement methods of emissions.

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10 E.g. in Helsinki Convention (Convention on the Protection of the Marine Environment of the Baltic Sea Area) there is a somewhat different definition of BAT (added 1992).

There is no international body focusing on the harmonization of emission measurements.

The steering group proposes severe attention to be paid to the question of harmonization and the necessary actions to be taken on different fora, e.g.

- in EU and OECD in preparing environmental legislation and controlling and monitoring mechanisms
- in UN, UNCTAD, UNEP, GATT/WTO, HELCOM, PARCOM in preparing international co-operation related to environmental matters or environment/trade interface.
- in EEA, EUROSTAT, OECD, UNSO, FAO, WHO in dealing with environmental statistics.
- in CEN, ISO in preparing standardization programmes including management of standardization activities under different committees.

It is essential that the implications of the use of different measurement methods are clearly understood. Among these are incomparability of data, risk assessment, biases and inefficiency in data production. This further stresses the need for increased efforts to eliminate differences in emission measurements at the national and international fora.

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Paris 4th June 1974	Convention for the Prevention of Marine Pollution from Land-based Sources ("PARCOM")
Paris 22nd September 1992	Convention for the Protection of the Marine Environment of the North-East Atlantic
Helsinki 22nd March 1974	Convention on the Protection of the Marine Environment of the Baltic Sea Area ("HELCOM", "Helsinki Convention 1974")
Helsinki 9th April 1992	Convention on the Protection of the Marine Environment of the Baltic Sea Area ("HELCOM 1992", "Helsinki Convention 1992")

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· Helsinki 8th July 1985	Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on the Reduction of Sulphur Emissions on their transboundary Fluxes by at least 30 per cent
· Sofia 31st November 1988	Protocol to the Convention on Long-range Transboundary Air Pollution concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes
Vienna 22nd March 1985	Vienna Convention for the Protection of the Ozone Layer ("Vienna Ozone Convention")
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· London 29th June 1990	Amendments, adjustments

· Nairobi 21st June 1991	Annex D
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Abbreviations

A	asetus (Decree)
art.	article (as a legal term)
BAT	best available techniques
BEP	best environmental practice
BATNEEC	best available techniques not entailing excessive cost
CEN	European Committee for Standardization (Comité Européen de Normalisation)
CENELEC	Comité Européen de Normalisation Electrotechnique
CODATA	International Council of Scientific Unions Committee on Data for Science and Technology
DIS	draft international standard
DS	Danish Standards Association (Dansk Standard)
EEA	European Environment Agency
EEC	European Economic Community
EIA	environmental impact assessment
EL	environmental label(ling)
ELV	emission limit value(s)
EMAS	eco-management and audit scheme
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EQS	environmental quality standard(s)
EU	European Union
EUROSTAT	Statistical Office of the European Union
FAO	Food and Agriculture Organization
FSC	Forest Stewardship Council
GATT	General Agreement on Tariffs and Trade
HELCOM	Helsinki Commission
ICC	International Chamber of Commerce
IPC, IPPC	integrated pollution prevention and control
IPCC	International Panel for Climate Change
ISO	International Organization for Standardization
L	laki (Act)
LCA	life cycle analysis
OECD	Organization for Economic Cooperation and Development
OJ	Official Journal of the European Communities
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
SFS	Suomen Standardisoimisliitto SFS ry (Finnish Standards Association)
TRS	total reduced sulphur
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environmental Programme
UNSO	United Nations Statistical Office
VTT	Technical Research Centre of Finland (Valtion teknillinen tutkimuskeskus)
WHO	World Healthy Organization

Annex: Interviews

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This report gives a short illustration about the importance and need for harmonization of pollution emission measurements.

As a conclusion, the report stresses the importance and need for actions to be taken in the field and lists, as examples, bodies which may be responsible for taking active role or step forward in the matter.

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